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AUTHOR Chatman, Steve; Jung, Loren
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ABSTRACT

This paper questions whether there is sufficient evidence, as presented in the popular press, to support special action to increase the supply of college and university faculty. The higher education popular press has published several forecasts of faculty shortages due to the mass retirement of expansion era faculty and the forecasted low numbers of doctoral graduates. These forecasts of national shortages encouraged a local study of faculty attrition in a four-campus university system. The local study considered factors not accounted for in national studies but important locally: whether disciplinary field of study or campus location (urban or rural) has been associated with faculty attrition in the recent past and should therefore be considered when modeling demand for new faculty. Discipline and institution location were found to have no significant effect on the likelihood of faculty to continue employment from year to year when faculty age was controlled. Although the retirement rate was expected to increase, no evidence of massed retirements producing an increased demand for new faculty was found. The lack of forecasted increases in demand for faculty locally lead to a reconsideration of national forecast studies, especially when it was determined that the age distribution of faculty across system campuses was similar to faculty nationwide. Contains 24 references. (Author)

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CONCERN ABOUT FORECASTS OF NATIONAL FACULTY SHORTAGES AND THE IMPORTANCE OF LOCAL STUDIES

Paper presented at the Thirty-First Annual AIR Forum, San Francisco (May, 1991).

Steve Chatman, Ph.D.
University of Missouri System

Loren Jung, Ph.D.
University of Missouri-Columbia

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Correspondence should be sent to Steve Chatman, Budget and Analytical Services, 104 University Hall, Columbia MO 65211.

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Jean Endo
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Forum Publications Editorial
Advisory Committee

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ABSTRACT

The higher education popular press has published several forecasts of faculty shortages due to the mass retirement of expansion era faculty and the forecasted low numbers of doctoral graduates. These forecasts of national shortages encouraged a local study of faculty attrition in a four campus university system. The local study considered two factors not accounted for in national studies but important locally -- whether disciplinary field of study or campus location (urban or rural) has been associated with faculty attrition in the recent past and should therefore be considered when modeling demand for new faculty. Discipline and institution location were found to have no significant affect on the likelihood of faculty to continue employment from year to year when faculty age was controlled. Although retirement rate was expected to increase, no evidence of massed retirements producing an increased demand for new faculty was found. The lack of forecasted increases in demand for faculty locally lead to reconsideration of national forecast studies, especially when it was determined that the age distribution of faculty across system campuses was similar to faculty nationwide. This paper questions whether there is sufficient evidence, as presented in the popular press, to support special action to increase the supply of faculty.

INTRODUCTION

Forecasts of demand for faculty clearly impact national policy and the policies of individual institutions. If higher education is facing a time of massed retirement of expansion era faculty, then higher education administrators should lobby for governmental assistance, examine early retirement policies, encourage graduate student enrollments, and experiment in new personnel policies before the shortage becomes critical. If however, there is no reason to expect unmet demand, then very different administrative actions are indicated.

This paper presents the results of a local study of faculty flow and demand that indicated little increase in demand for new faculty. Although the local and national studies used faculty distributions that were very similar, the forecasted results differed markedly. The local forecast showed a very consistent need for new faculty (less than 4% variation over 15 years) under conditions of constant enrollment, stable student to faculty ratios, and unchanged employment practices. Further examination of published forecasts of impending faculty shortages

and higher education's response to forecasts of faculty shortages in the 1950s lead to two conclusions. First, increased retirement rates will probably only slightly inflate demand for new faculty. Second, higher education has a history of being far more able to respond as a market entity than expected. Lastly, several of the assumptions made by those forecasting shortages may be questionable.

THE NATIONAL PICTURE

The warning of future faculty shortage was clearly given in Michael Sovern's New York Times Magazine article, "Higher Education: The Real Crisis" where he wrote, "at Columbia, nearly half of the tenured professors in the arts and sciences will retire in the 1990s. Colleges and universities all over the country are facing a massive wave of retirements." Examples of Chronicle of Higher Education opinion headlines supporting this position include, "Universities Must Lead the Effort to Avert Impending National Shortage of Ph.D.'s (1/17/90, p. B1) and "Colleges Should Look to Retired Professors to Cope with Looming Faculty Shortage" (1/3/90, p. B1). Faculty demographics have also been the subject of recent presentations and books warning of impending faculty shortages due to increased retirement rates of an aging faculty or to declining rates of Ph.D. production. These forecasts are apparently affecting perceived demand for faculty and may be too readily adopted by higher education professionals eager for information that might positively affect salaries, federal programs, and graduate enrollments. An example of the rapid acceptance of forecasts of increased faculty demand can be found in El-Khawas's most recent Campus Trends report (1989). El-Khawas reports that:

> "half of all colleges and universities reported it now takes longer to find qualified persons for full-time faculty positions" (p. 2).

The results were reflected in a Chronicle of Higher Education headline, "Job Market Begins Predicted Turnaround, Survey Indicates; Many Colleges Find It Difficult to Fill Faculty Vacancies" (7/25/90, p. 1). These observations and the opinions held by university administrators responding to the ACE survey are perhaps evidence of too ready acceptance of forecasts of an impending shortage in that even those who have predicted shortages have not predicted general shortages until the late 1990s. A clearer indication of too ready acceptance can be gleaned from comparing responses to the 1988 and 1989 reports. The 1989 Campus Trends reported that one-half of responding institutions had greater difficulty in getting top applicants to accept faculty positions (p. 18). This was up from 37% in 1988 (p. 24) and was used as evidence in support of forecasted shortages of faculty.

However, when asked if they were currently facing a shortage in 12 disciplines, fewer responded in the affirmative for 10 disciplines in 1989 than in 1988. When asked if they expected shortages in these same fields, more responded in the affirmative in five fields and less in seven fields. It seems peculiar that increased competition for top candidates would be inversely related to shortages by discipline.

Of authors publicly forecasting unmet need for new faculty: Lozier and Dooris, McGuire and Price, and Bowen and Sosa; each pair has focused on different aspects of faculty demand. Lozier and Dooris have focused on reasons for retirement and increases in retirement rates. McGuire and Price have focused attention on faculty demand at Higher Education Data Sharing Consortium (HEDS), private liberal arts, institutions. Bowen and Sosa have focused on faculty demand in the arts and sciences.

Lozier and Dooris (1990) suggest three forecasted patterns based on different assumed rates of attrition after age 50 and retirement at 65. Their forecasts suggest that retirements will increase by nine percent to 44% under alternate survival rates assumptions. They suggest a "standard" rate increase of 24%. However, as will be discussed in context of local patterns, retirement rates may well increase sharply as they suggest without producing an unusual demand for new faculty.

The McGuire and Price studies (1989 and 1990) of HEDS Consortium members differ in several ways from other studies in that: 1) the participating institutions were largely private, liberal arts institutions; 2) they computed a likelihood of continuation by faculty rank; 3) they assumed constant enrollment growth; and 4) all new faculty were assumed to be young assistant professors. Using these assumptions, they reported that new hires would increase by 33% (1989) from 1989 to 2005, increasing from 6.8% to 8.4% of all faculty (+24%). Their second study of a larger sample of HEDS institutions concluded that new hires would increase as a percentage of all faculty from 7.1% in 1990 to 8.3% in 2008 (+17%). Their 1990 study predicted that faculty retirements would continue to be about 27% of total new faculty hiring needs from 1990 to 2010. A major difference between these forecasts and those by other authors is the assumed mean annual growth rate of 0.86% (0.5% in their 1989 study).

A major work in this arena is clearly that of Bowen and Sosa (1989). Bowen and Sosa do not forecast an exodus of faculty but do forecast shortages due primarily to inadequate supplies of new Ph.D.s. Bowen and Sosa, in explaining the lack of evidence for bunched exits, suggested that their more steady forecasts were probably the result of the inclusion of other factors like deaths and quits. Specifically, they reported that "the flow

of present faculty members out of higher education will be remarkably steady over the next twenty to twenty-five years...we found no evidence to support claims that there will be anything like a cataclysmic bunching of exits" (pp. 26-27). In addition, they reported that the flow of young people through the system created a reasonably steady replacement demand that was relatively independent of retirements (p. 127).

Bowen and Sosa (1989) predicted that demand would exceed the supply of new Ph.D.'s beginning in 1997 and continuing through 2002 and that the phenomenon would vary by discipline within the arts and sciences. The demand for faculty in humanities, social sciences, mathematics, and physical sciences was projected to exceed the supply of new Ph.D.'s by 1997. They projected a tightening of the market but no excess demand in the biological sciences and psychology.

Whether higher education faces shortages of new faculty due to retirements or declining supplies, institutions should anticipate faculty demand locally as national shortages would exacerbate local shortages. The following section describes the creation of a Markovian transition matrix to model faculty flow by age group, discipline and campus within a university system.

THE LOCAL STUDY

Recent history of faculty transitions into and out of the university system was used to establish likelihoods of transition by age group, field of study, and campus. These likelihoods were incorporated into a Markovian matrix to support forecasted need for new faculty. For the purposes of this study, faculty demand was viewed in operational terms. That is, faculty transitions from one year to the next were classified into one of three operationally defined categories. Faculty members were classified as continuing, exiting, or new hires depending upon sequential annual relationships of employment. If they were employed in year one but not in year two, then they were exiting. If they were employed in year two but not in year one, then they were new faculty. The population included in this study were full-time (1.0 FTE) tenured, tenure-track, and nontenure-track faculty on active appointments as of October 31 with primary titles of professor, associate professor, assistant professor, or instructor. In addition to the regular transitions of new faculty, retiring faculty, and attrition due to death of faculty or changes in career plans, the operational definitions produced "Exiting" and "New" labels for some groups that might not be normally considered as such. For example, faculty moving to administrative appointments, going on sabbatical, etc., must be replaced and were therefore counted as "Exiting." Similarly, there

must be positions for tenured administrators returning to faculty positions or faculty returning from leave and so they were counted as "New Hires."

To produce relatively stable age-based transitions, transitions were determined across the preceding six years (five transitions). The first transition, from 1984 to 1985, was subsequently excluded because it evidenced lower likelihood of continuation than the transition years since 1984 to 1985 (86% versus 91%). The 1984 to 1985 difference in transition likelihood was partly the result of the first year of an early retirement program begun in 1984. The likelihood of continuation for the four transitions of 1985 to 1986 through 1988 to 1989 did not differ significantly. Therefore, the four annual transition ratios were combined to produce a relatively stable ratio. Similarly, new hires were combined across the four transitions to produce more stable distributions of new faculty. Table 1 reports the likelihood of faculty continuation by age group and campus. Across campuses, the likelihood of continuation begins and ends at about 75%. The highest continuation rates are found from 45- to 59-year-olds when faculty are unlikely to exit (about 95% continued). Table 1 also reports the outcome of Chi-square tests to determine whether continuation varied significantly by campus. No significant variation ($p > .01$) was found by campus (Chi Square $p > .01$).

Insert Table 1 Here

Variation by field of study was similarly examined by age group to determine whether faculty in one discipline might be more likely to continue than faculty of the same age in another discipline (Table 2). Faculty were placed into one of fifteen disciplinary areas. Analysis found no case of significant variation within age-group by field of study ($p < .01$). The lack of significant differences by campus and discipline supported the use of a single set of transition ratios throughout. A final test of variation was made to determine whether the pattern of continuation and termination varied over the past four transitions. The likelihood of continuation was unrelated to transition year in all but one case ($p > .01$) and that case did not present a general pattern of change. Faculty greater than 64 years old were more likely to retire in the 1985 to 1986 and 1987 to 1988 transitions. In conclusion, continuation and termination probabilities were determined across disciplines, campuses, and across the past five years (four transitions) because none of these factors were individually and consistently associated with the likelihood of continuation within age group. In other words, the same likelihood of continuation can apply to faculty within age ranges regardless of campus or field of study and there has been no important trend over the past five years (four transitions).

Insert Table 2 Here

Given the lack of significant difference by discipline, campus, or year for age range transitions, the computation of annual transitions was extended to specific years-of-age patterns. Annual transition likelihoods were determined for the university system group of all faculty because the use of system figures allowed sufficient numbers to determine transitions by years-of-age instead of age ranges. The use of years-of-age transitions created a smoother probability distribution across faculty age by allowing transitions to differ naturally within age ranges. For example, the 61- to 65-year-old age range histogram is smoothed by allowing for 65-year-old faculty transition rates to differ from those for 61-year-old faculty. Overall, the age range histogram of transition probabilities was made more curvilinear as would be normally expected.

To summarize, the transition ratios of continuing and exiting faculty were compared within five year age groupings to determine if differences in likelihood to continue varied by discipline or campus. It was recognized early that faculty age distributions varied by campus and that the likelihood of continuation varied by age. However, the likelihood of continuation within age groupings varied only by year for faculty greater than 64 years old. This lack of variation by discipline and campus proved important as it allowed transition likelihoods to be computed for the group of all faculty. In other words, mathematics faculty between the ages of 30 and 34 were as likely to continue as business faculty of the same age. Additionally, faculty from 30 to 34 at a campus in a small rural city were as likely to continue as faculty of the same age in a major metropolitan area.

The age distribution of new faculty members was determined for each discipline and campus matrix and the number of new faculty was allowed to vary by discipline or campus for the corresponding projections. In other words, it was assumed that the age distribution of future new faculty will be like the age distribution of new faculty of the last five years within that discipline or campus as there was no prior reason to assume equivalent age distributions of new faculty across campuses or disciplines. As each matrix predicts a need for new faculty each year, that need was met by distributing the number of new faculty needed according to the historic age distribution of new faculty.

Table 3 presents the anticipated faculty flow from fall 1990 to fall 2005 as a Markovian matrix. The 2,453 faculty count of 1989 was held constant under assumptions of stable enrollment, employment practices, and student to faculty ratios. To present the transition matrix in a more manageable table form, the age level transitions have been grouped into five year intervals. The matrix presents the transition of faculty from year to

year as "Continuing," "New," or "Exiting." Although faculty demand was determined by campus and discipline, this paper will describe only the local state university system faculty flow projections. Because the total number of faculty needed is held constant, the number of "New" faculty is a direct result of the number of "Exiting" faculty.

The most surprising pattern in Table 3 is the remarkable stability in number of new faculty needed and the change in distribution of faculty by age range. From fall 1990 through fall 2005, the number of new faculty is expected to vary by only eight (215 to 223). The number of those expected to "Exit" in the 56 to 60 age range will be nearly flat but those "Exiting" in the 61 to 65 age range are expected to increase from 28 to a high of 39 by 2001 (+39%) and those "Exiting" in the greater than 65 group are expected to increase from 10 to 18 by 2004 (+80%). However, these relatively large percent increases in "retirement rate" often amount to few faculty. For the university system, the increase is 19 more faculty members (9% of new faculty).

The second pattern of interest in Table 3 is the further change anticipated in the age distribution of faculty. From 1989 to 2005, the number of faculty in each age range below 51 years old is expected to decline and the number in each age range above 50 years old is expected to increase. Although the faculty distribution becomes more heavily weighted toward older faculty, the total number of faculty needed is relatively unaffected and mean faculty age is expected to increase by only about one and one-half years.

It is interesting to compare the Bowen and Sosa (1989) likelihood of continuation rates by age range with those used in this study. The Bowen and Sosa figures were computed from: Teachers Insurance and Annuity Association (TIAA) mortality rates, proportion tenured rates (from Survey of Doctorate Recipients figures), and assumed quit rates for tenured (1%) and non-tenured (10%) faculty. These were the "high-quit rates" (p. 195). Low quit rates were one-half of high-quit rates (p. 196). The five year "survival" probabilities used by Bowen and Sosa and those determined for the university system were similar. For comparison, university system annual rates were converted to five year rates using the relationship:

$$q = \frac{5(m)}{1+5/2(m)}$$

Where: q equals probability of exiting during a five year period and m equals the probability of exiting in one year.

Bowen & Sosa		Local State Univ. System	
Age Group	Survival Ratio	Age Group	Survival Ratio
30-34	.83	31-35	.39
35-39	.88	36-40	.62
40-44	.92	41-45	.76
45-49	.92	46-50	.88
50-54	.88	51-55	.88
55-59	.76	56-60	.78
60-64	.41	61-65	.59
65-69	.07	66-70	.56

Differences were slight in the 45- or 46- to 59- or 60-year-old ranges where the probability of exiting the university system was very small and was therefore more similar to a national pattern. The differences were greater at younger age ranges where exits reflect movement between universities and at the older age ranges where university system faculty are more likely to continue employment.

Insert Table 3 Here

The failure of this study to forecast increased demand for faculty compelled further examination. Four explanations readily presented themselves:

First, the age distribution of local faculty might have differed in important ways from the distribution of faculty nationally and have little generalizability;

Second, recent history may not be indicative of the near future;

Third, local state university forecasts using faculty exchange between institutions, may be inadequate examples of systems of faculty exchange nationally; and

Fourth, national forecasts may be misleading.

Neither the second or third competing explanations could be adequately addressed so attention was focused on assessing how representative local state university faculty are and concerns about criticism of published forecasts of faculty shortage.

The first concern, that local university system faculty may be distributed by age differently than faculty nationally and forecasts based on university system faculty would not be expected to mirror national forecasts, is readily examined. Nationally, mean faculty age has increased rapidly and the proportion of older faculty has increased dramatically. Across the state university system, mean faculty age has also increased rapidly. Mean age of faculty has increased by four years -- to 47 years old from fall 1981 to fall 1989 (Chatman & Jung, 1990). In addition, the percentage of faculty members 50 years old or older has increased from 36% in fall 1981 to 44% in fall 1989.

The mean age of full-time faculty nationwide, as reported by the NCES's 1988 National Survey of Postsecondary Faculty (Chronicle Almanac, 1990), was 47; the same as the university system. Evidence that the mean age of faculty is increasing nationally comes from Bowen and Sosa's (1989) analysis of "Survey of Doctorate Recipients." Responses show that the percentages of faculty both under 40 and over 49 has changed dramatically from 1977 to 1987 (Bowen & Sosa, Figures 2.2 & 2.3, pp. 19-20) and that aging has occurred across disciplines.

The eight disciplinary fields presented by Bowen and Sosa all show increase in the percentage of faculty over 49 and decrease in the percentage less than 40. Overall, mean faculty age increased from about 44 to 47 years old from 1977 to 1987. Table 4 presents the local fall 1989 age frequency and percentage distributions of faculty by discipline. It is apparent from Table 4 that faculty age varied locally by discipline ranging from a mean of 44 years in computer science to 49 years in education. The percentage of faculty members over 49 years old varied from 17% in law to 49% in education. Overall, about 37% of the faculty were above 49 years old. Comparisons with National Research Council Survey figures showed that the age distribution of university system faculty by discipline tended to be like the national pattern.

Insert Table 4 Here

Further evidence of the similarity of the age distribution of university system faculty and faculty nationwide can be gleaned from comparisons of the university system faculty distribution by age with several published distributions presented in Table 5 and as Figure 1: NCES's 1988 survey of 1987 faculty (Almanac, 1990); American Association of University Professors (AAUP) Biennial Survey distribution (Academe, 1990); McGuire and Price, 1989; McGuire and Price, 1990; and Bowen and Sosa, 1989. (Table 5 and Figure 1 also contain a NRC steady-state distribution that will be the subject of discussion later in the paper. Please ignore the NRC distribution now.) These distributions of somewhat different faculties, were very similar. A more recent

study, the 1989-90 University of California at Los Angeles Higher Education Research Institute (HERI) Faculty Survey (Chronicle, 1991), supports the contention that the age distribution of university system faculty was very like the distribution of faculty nationwide. The HERI survey's age distribution of 35,478 full-time professors at 392 colleges and universities used age groupings whose endpoints differed by one year but produced a distribution that was very similar to the state system distribution. The similarity between the age distribution of university system faculty and other distributions suggests that results of faculty flow models developed from the university system distribution may be generalizable to a wider group of faculty. At least, the local "sample" had age characteristics like the national population. Given that university system faculty have aged, as faculty nationally have aged, and were distributed by age group like faculty nationally; the finding that likelihood to continue was not associated with location or field of study may be generalizable to a broader group of faculty. Also of special interest at this time, the fact that local and national faculty were similarly distributed by age group foils a simple explanation for the difference between national and local forecasts of faculty demand. Finding evidence of increased retirement rate but no increase in faculty demand for a university system with faculty distributed by age similarly to the national distribution produced a dissonance that led to questions about published forecasts.

Insert Table 5 and Figure 1 Here

Criticism of Forecast Assumptions

Faculty flow models represent to varying degrees of complexity the interrelationship of demand and supply; both central components of forecasts of shortages. The interrelationship of supply-side shortages and demand-side shortages clearly impacts and is impacted by service delivery or personnel issues. While supply-side shortages, demand-side shortages, and personnel issues can not be easily separated, the following discussion has separated them for convenience. Shortages due to demand for faculty will consider future enrollments, an aging faculty, and increased faculty retirement rates. Supply shortages will consider the production of doctoral students. Personnel issues of instructional delivery will then be discussed. It will then be suggested that there is inadequate support for the position that there will be a faculty shortage and an alternative forecast, that higher education can respond to the limited increased demand as expected of a market entity, will be discussed in light of higher education's previously demonstrated ability to respond to increased demand for faculty in the 1960s.

Demand-Side Shortages

The faculty is aging and an aging faculty is a precursor of faculty shortages.

As shown earlier, the faculty locally and nationally have aged rapidly in the last decade. There is no argument that this has occurred. There can be disagreement as to whether this forewarns of increased retirements and faculty shortage. It is the position of this paper and of Bowen and Sosa that faculty age distribution is returning toward a more "normal" shape after being unusually skewed toward younger faculty. Evidence that we may be viewing a return to normality and concomitant positive features of increased retirement rates comes from a decade old NRC report. A model of steady-state faculty distribution by age was offered in the NRC report, "Research Excellence Through the Year 2000" (1979, p. 19). The NRC report determined that a steady-state faculty would have a mean age of 45 years and that 34.5% of faculty would be older than 50. These figures are relatively close to figures for the distribution of faculty nationally where the mean age is 47 and about 35% are older than 50.

A related issue concerns the retirement rate of faculty. Briefly, higher education researchers have estimated that faculty retirements will increase by 50% (Lozier & Dooris, 1987), later revised to 24% (Lozier & Dooris, 1990) and 37% (McGuire & Price, 1989). Loozier and Dooris's (1990) alarming forecasts of increased retirement rate trends suggest that the need for new faculty will increase at an equally alarming rate. As this local study illustrated, and as supported by Bowen and Sosa, dramatic increases in retirements do not necessarily result in dramatic increases in demand for faculty. Faculty retirement is one, relative small, component of faculty flow out of the profession. For the local state university system study, the 39% increase in retirements by those 61 to 65 and the 80% increase for those over 65 amounted to only an increased need of 19 faculty (9% of new faculty).

The following discussion makes reference to Table 5 and Figure 1 which are the results of efforts to compare several faculty age distributions, some interpolated from graphs or descriptive statistics. However, you will see that the distributions are very similar and are offered in comparison to the hypothetical steady-state distribution of the Academy report (NRC, 1979). The NRC report described a distribution created by a model in which there is: 1) a constant number of entrants each year into tenure track and non-tenure track positions; 2) a constant number of retirements (reaching age 65); 3) the age distribution of entrants is assumed to be the same as that of the 1978 cohort; and 4), that half will receive tenure after five years and the other half will leave

the system. In the hypothetical steady-state system, annual new hires are 5.6% of total faculty, 2.2% retire each year, and 9.2% are older than 60 (p. 214-221). In comparison to a steady-state system, it would appear that the percentage of faculty 50 years old and older is not particularly unusual. The greatest discrepancies between reported distributions and the steady-state system occur at the younger age levels (under 36) where fewer faculty are reported than a steady-state system would produce and more faculty than expected are in the 41- to 50-year-old range. If the NRC model's distribution can be compared to the other distributions as representing the distribution of faculty nationally, then two features are readily apparent. First, the national faculty is missing a younger age group. There are far too few 31- to 35-year-old faculty. Second, it is apparent that retirements will keep increasing for some time. If we were to face a retirement crunch in the next 15 years it would seem that we would then face a much larger crunch during the subsequent 10 years. In any event, the recently observed aging faculty and forecasted increases in retirement rates may both suggest returns to normal rates after periods of unusual suppression.

Demand for faculty will increase due to increased enrollment.

A second factor suggested as exacerbating faculty supply problems is increased enrollment. An assumption of Bowen and Sosa's and McGuire and Price's is that enrollment will increase due to increased numbers of high school graduates. This observation is supported by the Western Interstate Commission for Higher Education (WICHE), TIAA and College Board report High School Graduates: Projections by State, 1986 to 2004. According to this report, the number of high school graduates will increase from 1994 through 2004 (p. 9). Across this period, high school graduates will increase by about 466,000 (21%). However, by 2004 the number of high school graduates is only expected to recover to near 1982 levels. Additionally, this recovery will be largely confined to Southern and Western regions. NCES (1990) projections are less optimistic as they project only a recovery to current levels by 2000. In a broader time reference, there are several years before important growth in the number of high school graduates can be expected and that growth will be regionally specific.

This discussion suggests that demand-side shortages resulting from an aging faculty retiring or from increasing enrollment may be over-stated if attention is limited to the recent past and near future. It appears likely that post-secondary enrollment will increase, that the faculty has aged, and that retirement rates will increase. It is less clear that these changes will produce a shortage. Alternatively, they may represent a return

toward more normal patterns and be reasonably considered to be moderately increasing market pressures.

Supply-Side Shortages

Bowen and Sosa (1989) concluded that there would be a shortage of new faculty caused by continued low numbers of U.S. citizen and permanent resident doctorates. Relying on National Research Council's Survey of Earned Doctorates (SED), Bowen and Sosa (1989) projected "that there will be no change in the number of U.S. residents obtaining doctorates in most of the major fields of the arts and sciences" (p. 103). There are two clear problems with their assumption. First, they forecast stability for curvilinear trends each of which varied by field of study. Second, they apparently underestimated U.S. citizen enrollments.

Analysis by field of study found that mathematics, physics/astronomy, the social sciences, humanities, history, letters, and foreign languages show a peaked distribution around 1972-74 with rapid decline afterward. Chemistry, earth sciences, biological sciences, and psychology have shown consistent growth. Fixing future rates of graduates at current levels may simplify forecasting supply but it seems an oversimplification. An indication of the problem of forecasting doctoral production can be illustrated by comparing their 1992 and after forecasts (Table 6.2, p. 104) with NRC Summary Report 1989 figures (Appendices A-2 and B-1). Prediction error for humanities and social science was 835 (16%) with nearly 1,000 more U.S. residents receiving doctorates than predicted. In math and physical science their forecast was close but they underestimated U.S. residents by about 10%. In the biological sciences and psychology their forecast was about 6% too low and they underestimated U.S. residents by nearly 900. Overall arts and sciences, their forecast would be off by about 7% (1,149) with a U.S. resident error of about 17% (2,260). These differences are not precisely accurate as they compare 1989 and 1992 values, but they do suggest the difficulty in forecasting doctoral graduates. There is another problem with Bowen and Sosa's treatment of SED information. Reliance upon SED information restricts concern to earned doctorates instead of all faculty.

Bowen and Sosa's forecast of faculty shortages assumes that a fundamental measure of instructional delivery, student to faculty ratio, will remain constant. Of the four models examined by Bowen and Sosa, their preference appears to be their second model, a model of constant student to faculty ratio. This is in spite of their observation that the student to faculty ratio has dropped from 12.0 to 1 at Research I institutions in 1977 to 9.7 to 1 in 1987. Across institutional types, they report nearly a 30% drop in the student to faculty ratio (p. 76). The

decline has varied by discipline with biological sciences declining by 41%, humanities and social sciences by 32%, psychology by 26%, mathematics by 8%, and physical sciences remaining constant (p. 76). Given the recent decreases in student to faculty ratios, Bowen and Sosa might have attempted to vary the ratio to compensate for supply and demand conflicts. Specifically, they suggest that the imbalance of supply and demand will create excess demand instead of pursuing the perhaps simpler solution of allowing ratios to return toward 1977 levels. Their areas of projected faculty deficit by 1997: humanities, social sciences, mathematics, and physical sciences; were, with the exception of physical sciences, areas where changes in student to faculty ratios might easily offset the excess demand. Computations by this author, based on projected FTE students and faculty (from Bowen & Sosa Tables 2.4 and 4.1) showed that the excess demand could be offset across arts and sciences by continued declining ratios, relative to 1987 levels, of 3.9% in 1992, 6.5% in 1997 and 0.2% in 2002. After 2002, the ratio could then vary above 1987 rates by 4.0% in 2007 and 4.3% in 2012. In any event, the increase in ratios from 1987 levels would be much less than the decline of the last ten years. In other words, the projected demand would seem to be easily offset by a modest return toward, but not reaching, 1977 student to faculty ratio levels in most cases. The student to faculty ratios needed to meet demand in the arts and sciences under Bowen and Sosa's second model are presented in Table 6. Notice that only in the physical sciences would the necessary ratio exceed previously experienced (1978) ratios and then only by 3.4%.

This argument about the stability of student to faculty ratios may be moot if the ratios used by Bowen and Sosa were inaccurate. Concern should be raised about the appropriateness of degrees conferred in arts and sciences as a direct measure of credit hours produced in arts and sciences. Bowen and Sosa used degrees conferred and changes in degrees conferred as a proxy for credit hour production. Later in this report it will be stated that student to faculty ratios at a national level across fields of study have been relatively constant over the past 30 years. The two positions might be in conflict or their different spheres of interest might be sufficient to allow each to be valid. In any event, Bowen and Sosa's observations regarding student to faculty ratio in arts and sciences should be limited to arts and sciences faculty needs.

Other instructional delivery policies that would easily offset excess demand forecast by Bowen and Sosa include an increase in usual instructional load, use of technology to deliver instruction more efficiently, and increasing class sizes. The simple increase from six to nine or from nine to 12 contact hours would meet projected demand as would the use of video delivery systems. It is also possible that: 1) the reward structure will

change to attract current graduates to academe; 2) part-time and not on track faculty will be offered full-time tenure track appointments; and 3) employment possibilities will attract doctorates working in government or industry to academe.

Summary of Concerns About Forecasts of Faculty Shortages

Assumptions used to forecast faculty demand: that post-secondary enrollments will increase exacerbating the need for additional faculty; that an aging faculty is evidence in support of forecasts of massed retirements and increased demand; that Ph.D. production will continue at current levels; and that existing student to faculty ratios will continue into the future; may not be reasonable in light of more long-term patterns. Increased enrollments are increases only when compared to recent troughs. An aging faculty can be viewed as a return to a more steady faculty demand. Retirement rates may increase but the increase will probably have a small impact on total demand for new faculty. And, patterns that have shown little stability should probably not be projected as stable.

It is further suggested that these forecasters have not examined historical relationships of faculty supply and demand. History suggests that higher education is remarkably resilient and responsive to market demands and has regularly frustrated forecasters.

Insert Table 6

HISTORICAL FORECASTS OF FACULTY SHORTAGES

Current faculty shortage forecasts are reminiscent of those of the 1950s. Those warnings of 30 to 40 years ago included the Committee of 15 warning in Graduate School, Today and Tomorrow, "Even if all these new Ph.D.'s were to become teachers, we would, by 1970, need approximately 350,000 more college teachers than we shall probably train in our doctoral programs" (Strothman, 1955, p. 7) or Wolfle's comments in America's Resources of Specialized Talent (1954, pp. 43, 136),

> "If the trend relating the number of doctors' to the number of bachelors' degrees continues into the future, and if bachelors' degrees follow the projections given [above], about 6,600 doctors' degrees can be expected in 1960 and 12,000 in 1970. [Actual figures were 9,829 and 29,866.] ... It will be impossible to meet all the demands stated above by hiring new college graduates."

A last illustration of the looming shortage perceived in the 1950s comes from the President's Committee on

Education Beyond the High School, Second Report to the President (1957), stated "present estimates based on relatively optimistic assumptions indicate that there may be only one new Ph.D. available for every 4 or 5 new college teachers needed between now and 1970" (p. 30). These quotes can be found in Allan Cartter's Ph.D's and the Academic Labor Market (1976) and in a 1965 article in Educational Record in which Cartter is reflecting upon why his forecasts and those of his contemporaries appeared so inaccurate upon reflection. Cartter's observation in 1965 (p. 267) was particularly interesting,

> "Anyone who reads, even casually, the literature concerning the future state of higher education could well be convinced that this country faces a crisis in an impending shortage of qualified college and university teachers. However, a review of expert opinion over a fifteen-year period reveals an anomaly: the crisis always seems to be pending; it is rarely present."

It is this paper's position that those currently forecasting shortages are repeating the error of 1950's forecasters. Specifically, higher education has proved itself to be a market driven entity that is able to quickly respond to changes in supply and demand. Student to faculty ratios across time will be used to illustrate the ability of higher education to meet market demands. Table 7 shows the student to faculty ratios reported by Cartter (1976, p. 103) from compilation of various U.S. Office of Education, Projections of Educational Statistics reports, from 1958 through 1972. FTE enrollment during this period increased by 167% (from 2,658,000 to 7,094,000). FTE faculty increased by 150% (from 188,000 to 471,000). Interestingly, and apparently contrary to simple supply/demand relationships, the most rapid period of enrollment growth, 1964 to 1968, saw a decline in student to faculty ratio. In addition, the ratio increased during two periods of more modest growth, 1958 to 1963 and from 1969 to 1972. Cartter additionally noted that the ratio of full-time faculty to all instructional staff increased from 1962 to 1972 and that the percentage of faculty with Ph.D.'s increased from 1954 to 1965 (p. 15). Clearly, higher education and the market for highly educated people have demonstrated the ability to respond well to changing market conditions and it is this paper's position that higher education will, in all likelihood and without evidence to the contrary, do so again.

Insert Table 7 Here

Table 8 continues the distribution of student-faculty ratios from 1975 to 1988 with projections to 2000 (NCES, 1990). Again, there has been very little change in the student-faculty ratio. The range of student-faculty ratios varies from 15.9 to 14.9 over the thirteen year period. The FTE faculty figures in Table 8 were estimated

from full- and part-time distributions of students and faculty which probably explains the jump in reported ratio from 1958-1972 to 1975-1988. It should be clear, however, that the ratio itself varies little across time when computed consistently as would be the case with a responsive market-based system.

Insert Table 8 Here

SUMMARY

This study was begun to examine whether the forecasts of massed faculty retirements and faculty shortages being reported in the higher education press and at conferences would impact faculty need within a university system. The model of faculty flow described in this study forecasted a very stable need for new faculty. The lack of excess demand for new faculty was contrary to national forecasts and led to a comparison of this and other studies. In general, it was found that those projecting increased faculty retirements may well be correct but that the increase in retirements would create a shortage only under assumptions constraining higher education's ability to respond to changes in market conditions. It is asserted that assumptions of continued low numbers of U.S. doctoral graduates are assumptions based on atypical conditions. Response to changing conditions has been clearly evident throughout the previous 30 years and there is no reason to assume that responsiveness to change will stop. Higher education's ability to respond to changing markets, especially changes in demand for faculty due to enrollment growth, is evidenced by the relative stability of student to faculty ratios over time. It is assumed that stability in student to faculty ratios over an extended period of rapid enrollment change (1958-1972) is a key indicator of higher education's ability to respond to market conditions.

It should also be noted that the current distribution of faculty evidences especially low numbers of young faculty caused by an extended period of relatively limited employment opportunities. Far from being cause of alarm, the anticipated increase in faculty retirements can be seen as presenting an opportunity for rejuvenation. It will be interesting to note whether the threatened malaise warned by the National Research Council's Committee on Continuity in Academic Performance, a declining research vitality caused by a shortage of openings for young faculty (NRC, 1979, p. vi), has been evident or will at least seem to have been present as a relatively larger group of young faculty are hired.

Whether the next decades will see a rejuvenation of faculty or alarming shortages of highly educated people will depend upon the extent to which the system responds to market conditions. It should be clear from

this and other works: notably Bowen and Sosa, 1989, and McGuire and Price, 1990; that increases in retirements will not likely cause a shortage unless graduate student production continues at its current low rate. It is this author's opinion, supported by history, that higher education has demonstrated its ability to respond to the market during the enrollment patterns of the past thirty years and has maintained very stable student to faculty ratios throughout without lessening standards. In fact, the percentage of faculty with the Ph.D. actually increased during the time of most rapid growth (Cartter, 1976; Table 2-2, p. 17).

Projections that fail to consider that higher education has responded to the market for highly educated people through a variety of means: changing student to faculty ratios within disciplines, decreasing median time to degree completion, and hiring relatively more or less of its Ph.D. graduates; will warn of a future that is unlikely. It appears short-sighted to impose linear or monotonic behavior on parameters that have historically showed much variation. Higher education has responded to past changes in demand for Ph.D.'s and, will in all likelihood, respond to future changes in demand. In conclusion, the increase in retirement rates of full-time faculty presents a challenge to revitalize higher education that higher education will meet as it has met past challenges.

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Table 1: Faculty Annual Rate of Continuation by Age–Group and Campus

FALL 1985 TO 86 THROUGH FALL 1988 TO 89

	< 31	31–35	36–40	41–45	46–50	51–55	56–60	61–65	> 65
Main Campus	78%	85%	87%	91%	94%	96%	94%	83%	74%
1st Urban Campus	67%	83%	93%	94%	96%	99%	96%	90%	82%
Specialized Campus	83%	87%	93%	89%	97%	98%	97%	85%	77%
2nd Urban Campus	83%	91%	91%	94%	95%	96%	98%	92%	76%
Total	77%	86%	89%	91%	95%	97%	96%	85%	76%
Continuing and Exiting	136	837	1,356	1,566	1,622	1,468	1,182	846	455

NOTE: Pattern of continuation did not deviate by campus within age–grouping (X,p> .01)

Table 2: Percentage of Faculty Continuing by Age–Group and Field of Study

FALL 1985 TO 86 THROUGH FALL 1988 TO 89

Field of Study	< 31	31–35	36–40	41–45	46–50	51–55	56–60	61–65	> 65
Agriculture	83%	89%	89%	95%	94%	96%	96%	77%	75%
Business	87%	90%	84%	86%	96%	98%	94%	87%	70%
Communications	75%	93%	91%	88%	92%	85%	84%	92%	82%
Computer Science	50%	94%	90%	92%	88%	100%	100%	67%	50%
Education	100%	84%	90%	90%	94%	97%	95%	85%	78%
Engineering	75%	87%	92%	93%	94%	97%	94%	84%	81%
Fine Arts	100%	84%	98%	94%	97%	96%	94%	92%	77%
Home Economics	50%	82%	84%	94%	98%	96%	85%	57%	50%
Humanities	60%	77%	81%	87%	94%	97%	95%	89%	79%
Law		85%	93%	93%	93%	95%	91%	82%	20%
Life Sciences	50%	87%	94%	93%	93%	95%	96%	88%	77%
Mathematics	82%	82%	88%	90%	97%	100%	100%	86%	91%
Physical Science	86%	87%	89%	92%	95%	98%	98%	93%	69%
Psychology	71%	86%	95%	87%	98%	95%	97%	87%	100%
Social Sciences	75%	84%	87%	96%	96%	99%	98%	80%	71%
Total	77%	86%	89%	91%	95%	97%	96%	85%	76%
Continuing and Exiting	136	837	1,356	1,566	1,622	1,468	1,182	846	455

NOTE: Pattern of continuation did not deviate by field within age–grouping (X,p> .01)
Too few faculty less than 30 to make a valid test.

Table 3: Projected Systemwide Faculty Need Across Disciplines

Actual Faculty Data 1989, Projected Data 1990 - 2005

Age Group	Empl Type	Percent History	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
< 31	Cont	82%	40	31	35	32	31	30	30	30	30	30	30	30	30	30	31	31	31
	Exit	18%		11	11	10	10	10	9	9	9	9	10	10	10	10	10	10	10
	New		40	35	35	35	35	35	35	35	35	36	36	36	36	36	36	37	37
	Total		80	67	71	67	66	66	65	65	65	65	66	66	66	67	67	67	67
30-35	Cont	86%	213	225	210	197	192	181	176	178	176	176	176	176	177	178	179	180	180
	Exit	14%		36	34	32	32	30	28	29	29	29	29	29	29	29	29	29	29
	New		70	58	58	58	58	58	58	58	58	59	59	59	60	60	60	60	60
	Total		283	283	268	256	251	240	234	236	235	234	235	235	236	238	239	240	241
36-40	Cont	90%	323	328	323	320	311	312	313	306	299	297	291	288	290	290	291	292	293
	Exit	10%		40	40	39	38	38	38	37	37	36	36	35	35	35	36	36	36
	New		56	48	49	49	49	49	48	48	49	49	49	49	50	50	50	50	50
	Total		379	376	372	369	359	361	361	354	347	345	340	337	340	340	341	342	343
41-45	Cont	92%	364	369	374	370	366	361	360	358	355	349	350	351	347	344	344	341	340
	Exit	8%		34	35	35	35	34	34	34	34	33	33	33	33	32	32	32	32
	New		48	36	37	37	37	37	36	36	36	37	37	37	37	38	38	38	38
	Total		412	405	411	407	402	397	396	394	392	386	387	388	385	382	381	379	378
46-50	Cont	95%	378	374	367	363	373	373	369	374	371	367	364	364	363	361	358	359	360
	Exit	5%		20	20	20	21	21	20	20	20	20	20	20	20	20	20	20	20
	New		23	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
	Total		401	389	383	379	389	389	385	390	387	383	380	380	379	378	374	375	376
51-55	Cont	96%	358	395	390	392	390	382	372	367	363	371	372	368	373	371	368	365	366
	Exit	4%		13	13	13	13	12	13	12	12	12	12	12	12	12	12	12	12
	New		16	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Total		374	406	401	404	402	393	383	379	375	383	383	380	385	383	380	377	378
56-60	Cont	95%	287	279	298	317	310	334	360	356	358	356	349	341	337	334	341	342	339
	Exit	5%		13	14	15	14	16	17	17	17	17	17	16	16	16	16	16	16
	New		3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Total		290	282	301	321	314	338	364	359	362	360	352	345	341	338	345	345	343
61-65	Cont	82%	153	165	165	167	187	188	180	192	206	204	219	232	227	229	226	223	219
	Exit	18%		28	28	28	29	31	32	32	33	34	36	38	39	39	38	38	37
	New		4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5
	Total		157	170	169	171	191	192	184	197	210	208	223	237	232	234	230	227	223
> 65	Cont	77%	75	73	75	76	76	75	77	77	78	85	85	83	87	92	93	98	101
	Exit	23%		19	23	25	26	26	25	25	26	28	27	27	28	30	31	32	32
	New		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Total		77	74	77	78	78	77	79	79	80	87	87	85	89	94	95	100	103
Total	Cont	91%	2,191	2,238	2,236	2,236	2,236	2,236	2,237	2,237	2,237	2,235	2,234	2,233	2,231	2,230	2,229	2,229	2,229
	Exit	9%		216	217	217	217	217	216	216	217	218	219	220	222	223	224	224	224
	New		262	215	217	217	217	216	216	215	216	218	218	219	221	223	223	223	223
	Total		2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,452	2,452	2,452	2,452
Mean Age			46.8	47.0	47.1	47.4	47.5	47.7	47.8	47.9	48.0	48.1	48.1	48.2	48.2	48.2	48.2	48.2	48.2

Total faculty held constant under steady-state model.

Actual transitions determined by age level. Table aggregates age level transitions into age ranges.

Table 4: Local University System Faculty Age Distribution by Field of Study (Fall, 1989)

Frequency

	< 30	30–34	35–39	40–44	45–49	50–54	55–59	60–64	> 64	Sum
Agriculture	14	43	39	51	40	22	37	18	12	276
Business	6	23	20	23	27	17	9	11	4	140
Communications	3	9	18	27	11	12	12	9	5	106
Computer Science	2	10	9	8	5	6	7	0	1	48
Education	6	10	40	34	33	56	33	19	8	239
Engineering	11	32	41	38	44	57	35	16	14	288
Fine Arts	6	15	23	23	17	15	22	7	9	137
Home Economics	2	10	7	14	15	11	5	1	0	65
Humanities	2	23	49	62	71	58	34	23	8	330
Law	0	7	13	11	9	4	1	3	0	48
Life Sciences	2	20	37	44	39	25	17	18	5	207
Mathematics	6	19	17	15	22	14	12	5	3	113
Physical Science	8	23	19	16	25	35	27	15	2	170
Psychology	8	14	15	5	10	11	8	5	3	79
Social Sciences	4	25	32	41	33	31	31	7	3	207
Total	80	283	379	412	401	374	290	157	77	2,453

Percentage

	< 30	30–34	35–39	40–44	45–49	50–54	55–59	60–64	> 64	Mean Age	Percent Over 49 UM	Percent Over 49 U.S.
Agriculture	5%	16%	14%	14%	8%	13%	7%	4%	4%	46	29%	
Business	4%	16%	14%	16%	19%	12%	6%	8%	3%	45	29%	
Communications	3%	8%	17%	25%	10%	11%	11%	8%	5%	47	36%	
Computer Science	4%	21%	19%	17%	10%	13%	15%	0%	2%	44	29%	
Education	3%	4%	17%	14%	14%	23%	14%	8%	3%	49	49%	
Engineering	4%	11%	14%	13%	15%	20%	12%	6%	5%	47	42%	
Fine Arts	4%	11%	17%	17%	12%	11%	16%	5%	7%	47	39%	
Home Economics	3%	15%	11%	22%	23%	17%	8%	2%	0%	45	26%	
Humanities	1%	7%	15%	19%	22%	18%	10%	7%	2%	48	37%	43.8%
Law	0%	15%	27%	23%	19%	8%	2%	6%	0%	44	17%	
Life Sciences	1%	10%	18%	21%	19%	12%	8%	9%	2%	47	31%	36.3%
Mathematics	5%	17%	15%	13%	19%	12%	11%	4%	3%	45	30%	31.3%
Physical Science	5%	14%	11%	9%	15%	21%	16%	9%	1%	48	46%	
Psychology	10%	18%	19%	6%	13%	14%	10%	6%	4%	44	34%	37.0%
Social Sciences	2%	12%	15%	20%	16%	15%	15%	3%	1%	46	35%	34.5%
Total	3%	12%	15%	17%	16%	15%	12%	6%	3%	47	37%	

Note: U.S. values as reported by Bowen and Sosa (1989, p. 19) — From National Research Council Survey of Doctorate Recipients.

Table 5: Faculty Age Distributions from a Variety of Sources: Including a Hypothetical Steady-State Model

Age Distribution

Age Range	NRC Steady-State	McGuire & Price 89	McGuire & Price 90	AAUP Biennial	Bowen & Sosa 89	NCES	Local Univ. System
<31	5.6%	5.1%	3.5%	3.0%	0.5%	1.0%	2.3%
31-35	17.4%	9.6%	12.1%	12.0%	6.9%	11.3%	10.1%
36-40	15.5%	15.4%	17.2%	17.0%	14.3%	19.7%	15.2%
41-45	13.8%	18.1%	17.4%	16.0%	19.0%	18.3%	16.8%
46-50	13.4%	18.1%	16.1%	15.0%	20.4%	16.9%	16.5%
51-55	13.0%	15.6%	13.1%	13.0%	15.0%	14.4%	15.4%
56-60	12.3%	10.9%	10.4%	11.0%	11.8%	11.4%	12.6%
>60	9.2%	7.3%	10.4%	13.0%	12.1%	7.0%	11.1%

Sources:

NRC theoretical Steady-State distribution (Table D-2, p. 217).

McGuire and Price (1989) derived from reported mean and standard deviation (Table 1) Based on sample of 29 Higher Education Data Sharing Corsortium members (3541 faculty) all liberal arts colleges ranging from 38 to 303 full-time faculty.

McGuire and Price (1990) estimated from age distribution graphic ("Faculty Distribution") of 7,954 faculty. Institutions were part of Higher Education Data Sharing Consortium (largely liberal arts).

AAUP (1990) is from the Biennial Survey Institutions (30,019 faculty in 40 institutions: 26 category I with 27,546 faculty; 3 category IIA with 463 faculty; and 11 category IIB with 1,741 faculty). AAUP percentages are rounded to "one's" place.

Bowen and Sosa (1989) distribution is of arts and sciences faculty with doctorates as reported from the Survey of Earned Doctorates as of 1987 for five sectors (research I, other research/doctorate, comprehensive, liberal arts I, and other 4-year [Table 7.2]).

NCES figures were from 1988 survey of 1987 full-time faculty members at four-year institutions (11,013 faculty at 480 colleges and universities). As reported in Chronicle, "Almanac" (9/5/90, p. 22).

Local University figures are full-time faculty counts for the four campus system as of fall, 1989 (2,391 faculty).

Figure 1: Faculty Age Distributions

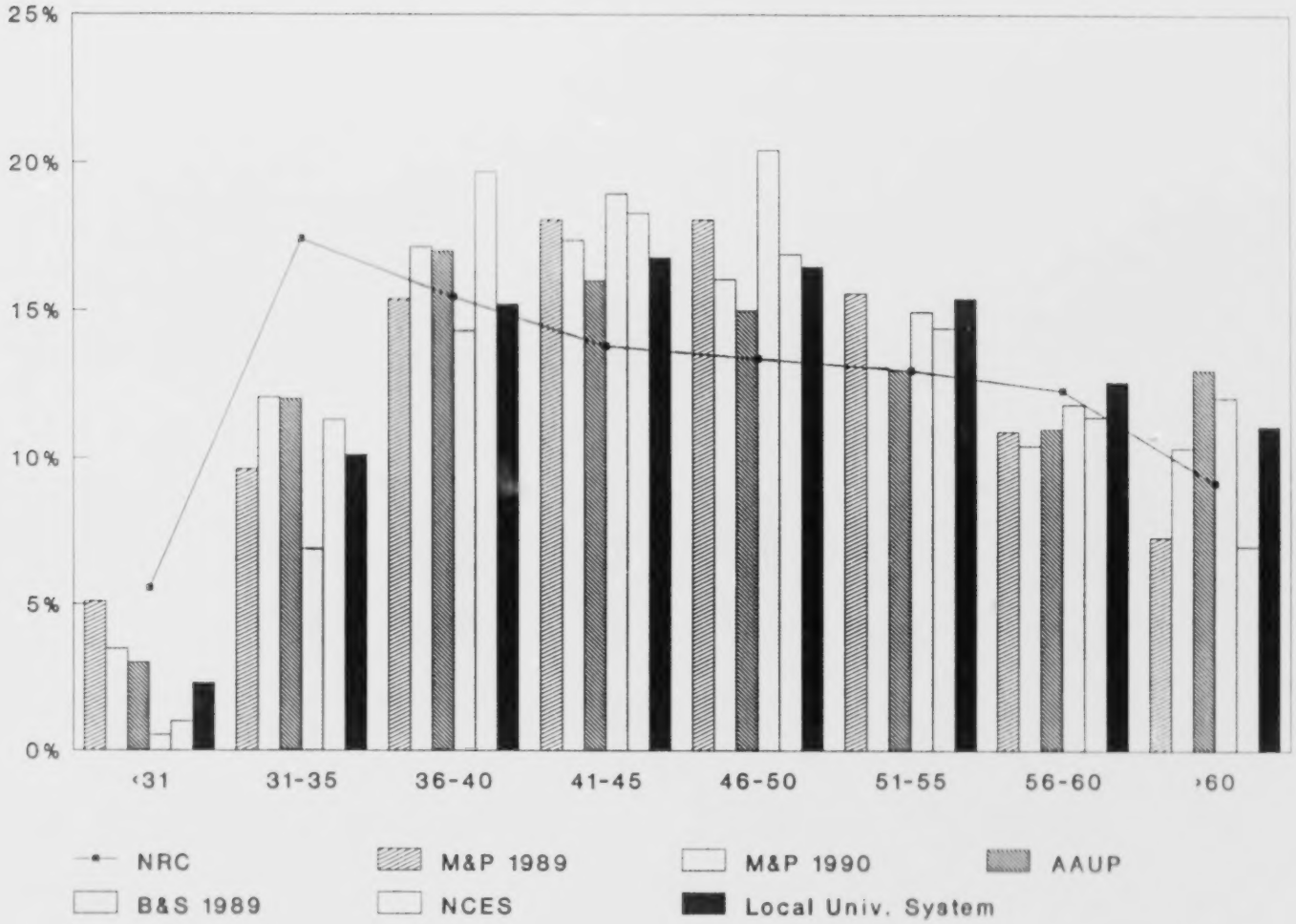

Table 6: Student/Faculty Ratio Required to Offset Increased Enrollments

Field of Study	Faculty Totals Held Constant at 1987 Levels				
	1992	1997	2002	2007	2012
Humanities & Social Sci.	10.3	10.0	10.7	11.1	11.2
Math	7.2	7.0	7.5	7.8	7.9
Physical Science	5.9	5.7	6.1	6.4	6.4
Biological Science	7.1	7.0	7.4	7.7	7.8
Psychology	13.7	13.4	14.2	14.8	14.9
Total	9.2	9.0	9.6	10.0	10.0

Field of Study	Relative to 1987 Ratios				
	1992	1997	2002	2007	2012
Humanities & Social Sci.	-4.7%	-7.3%	-1.1%	3.1%	3.4%
Math	-4.7%	-7.3%	-1.1%	3.1%	3.4%
Physical Science	-4.7%	-7.3%	-1.1%	3.1%	3.4%
Biological Science	-4.7%	-7.3%	-1.1%	3.1%	3.4%
Psychology	-4.7%	-7.3%	-1.1%	3.1%	3.4%
Total	-3.9%	-6.5%	-0.2%	4.0%	4.3%

Field of Study	As Percent of 1978 Ratios				
	1992	1997	2002	2007	2012
Humanities & Social Sci.	64.3%	62.6%	66.8%	69.6%	69.8%
Math	87.3%	84.9%	90.6%	94.4%	94.7%
Physical Science	95.3%	92.7%	98.9%	103.1%	103.4%
Biological Science	56.3%	54.8%	58.4%	60.9%	61.1%
Psychology	70.4%	68.5%	73.1%	76.1%	76.4%
Total	68.4%	66.5%	70.9%	73.9%	74.2%

Computed by using Bowen & Sosa (1989) ratios (Figure 5.2), enrollment figures from Table 4.1 (p. 46), to determine field of study enrollments.

Table 7: Student–Faculty Ratios from 1958 to 1972

Year	FTE Enrollments (in 1000s)	% Annual Change	FTE Faculty (in 1000s)	% Annual Change	Student–Faculty Ratio	% Annual Change
1958	2658		188		14.1	
1959	2775	4%	194	3%	14.3	1%
1960	2943	6%	204	5%	14.4	1%
1961	3198	9%	214	5%	14.9	4%
1962	3457	8%	228	7%	15.2	1%
1963	3701	7%	242	6%	15.3	1%
1964	4117	11%	274	13%	15.0	-2%
1965	4688	14%	317	16%	14.8	-2%
1966	5080	8%	351	11%	14.5	-2%
1967	5477	8%	378	8%	14.5	0%
1968	5954	9%	413	9%	14.4	-1%
1969	6314	6%	431	4%	14.6	2%
1970	6712	6%	452	5%	14.8	1%
1971	7005	4%	466	3%	15.0	1%
1972	7094	1%	471	1%	15.1	0%

Source: Cartter's 1976 report of U.S. Office of Education data from various year's reports of, Projections of Educational Statistics

Table 8: NCES Report of Student/Faculty Ratios (1975-1988) with Projections to 2000

(In Thousands)

	Instructional Staff				FTE Student Enrollment (1)					Gross
	Full-time	Part-time	Total	Est. FTE (2) Faculty	4 Year	2 Year	Graduate	1st Prof.	Total FTE Students	FTES/FTEF Ratio
1975	440	188	628	534	4,914	2,579	758	229	8,480	15.9
1976	434	199	633	534	4,838	2,461	781	236	8,316	15.6
1977	448	230	678	563	4,919	2,479	776	240	8,414	14.9
1978	439	229	668	554	4,918	2,406	779	248	8,351	15.1
1979	445	230	675	560	4,989	2,469	778	249	8,485	15.2
1980	450	236	686	568	5,109	2,657	790	263	8,819	15.5
1981	461	244	705	583	5,188	2,765	801	262	9,016	15.5
1982	462	248	710	586	5,194	2,841	790	266	9,091	15.5
1983	471	254	725	598	5,254	2,841	805	266	9,166	15.3
1984	462	255	717	590	5,215	2,661	814	263	8,953	15.2
1985	459	246	705	582	5,204	2,649	829	261	8,943	15.4
1986	459	263	722	591	5,241	2,704	859	259	9,063	15.3
1987	466	269	735	601	5,361	2,743	867	257	9,228	15.4
1988	467	275	742	605	5,349	2,753	899	266	9,267	15.3
	Projected Values				Projected Values					
1989	475	279	754	615	5,454	2,813	906	267	9,440	15.4
1990	479	283	762	621	5,506	2,833	911	269	9,519	15.3
1991	476	286	762	619	5,486	2,820	919	269	9,494	15.3
1992	469	286	755	612	5,412	2,790	917	269	9,388	15.3
1993	463	286	749	606	5,330	2,772	920	270	9,292	15.3
1994	459	285	744	602	5,279	2,766	915	267	9,227	15.3
1995	458	285	743	601	5,273	2,767	908	263	9,211	15.3
1996	461	284	745	603	5,308	2,788	901	261	9,258	15.4
1997	466	284	750	608	5,368	2,811	898	259	9,336	15.4
1998	474	284	758	616	5,456	2,845	893	259	9,453	15.3
1999	482	283	765	624	5,549	2,878	891	259	9,577	15.4
2000	489	283	772	631	5,631	2,900	888	257	9,676	15.3

(1) Full-time Equivalent enrollment in all institutions of higher education (Table 23, p. 48)

(2) FTE faculty figures were estimated as 1/2 part-time staff plus full-time instructional staff (Table 35, p. 81).